

WHAT IS CLAIMED IS:

1. A plasma-based method of etching a film of hardly-etched material formed on a substrate using said film and a mask formed on said hardly-etched film, said method comprising the step of:

etching said film of hardly-etched material using said mask having a side wall angled at 90 degrees or less with respect to the surface of said substrate.

2. An etching method according to claim 1, wherein:

said film is one selected from a group of materials consisting of Fe, Co, Mn, Ni, Pt, Ru, RuO₂, Ta, Ir, IrO₂, Os, Pd, Au, Ta₂O₅, PZT, BST, SBT, Al₂O₃, HfO₂, ZrO₂, GaAs and ITO.

3. A plasma-based method of etching a film of hardly-etched material formed on a substrate using said film and a mask formed on said hardly-etched film, said method comprising the step of:

etching said film of hardly-etched material using said mask having a side wall formed with a taper angle of less than 90 degrees with respect to the surface of said substrate, to form said etched film with a taper angle with respect to the surface of said substrate equal to or larger than the taper angle of said mask.

4. A plasma-based method of etching a film of hardly-etched material formed on a substrate using said film and a mask formed on said hardly-etched film, said

method comprising the steps of:

forming said mask such that a side wall of said mask has a taper angle to the surface of said substrate less than 90 degrees; and

etching said film of hardly-etched material using said mask.

5. A method of etching a film of hardly-etched material according to claim 4, wherein:

said step of forming said mask includes the step of etching said mask.

6. A method of etching a film of hardly-etched material according to claim 5, wherein:

said step of etching said mask includes the step of adjusting an etching condition for said mask to adjust the taper angle of said mask.

7. A method of etching a film of hardly-etched material according to claim 6, wherein:

said etching condition is at least one of a composition of a gas introduced into an etching chamber and an etching pressure.

8. A method of etching a film of hardly-etched material according to claim 5, wherein:

said step of etching said mask includes the step of adjusting at least one of a thickness of said film and an etching time for said mask to adjust the taper angle of said mask.

9. A method of etching a film of hardly-etched material according to claim 5, wherein:

said step of etching said mask includes the step of adjusting at least one of the size of a photoresist mask formed on said mask, and an etching time for said mask to adjust the taper angle of said mask.

10. A method of etching a film of hardly-etched material according to claim 5, wherein:

said step of etching said mask includes the steps of washing said mask in the middle of etching said mask, and subsequently etching again said mask.

11. A method of etching a film of hardly-etched material according to claim 10, wherein:

said step of etching said mask includes the step of adjusting at least one of the size of a photoresist mask formed on said mask, and an etching time for said mask before said step of washing to adjust the taper angle of said mask.

12. A method of etching a film of hardly-etched material according to claim 4, wherein:

said film is one selected from a group of materials consisting of:

Fe, Co, Mn, Ni,

Pt, Ru, RuO₂, Ta, Ir, IrO₂, Os, Pd, Au, Ti, TiO_x, SrRuO₃, (La, Sr)CoO₃, Cu(Ba, Sr)TiO₃, SrO: SrTiO₃, BTO: BaTiO₃, SrTa₂O₆, Sr₂Ta₂O₇, ZnO, Al₂O₃, ZrO₂, HfO₂, Ta₂O₅, Pb(Zr, Ti)O₃, Pb(Zr, Ti)Nb₂O₈, (Pb, La)(Zr, Ti)O₃, PbTiNbO_x, SrBi₂Ta₂O₉, SrBi₂(Ta, Nb)₂O₉, Bi₄Ti₃O₁₂, BiSiO_x, Bi_{4-x}La_xTi₃O₁₂, and InTiO.

13. A method of fabricating a semiconductor device using at least one layer of hardly-etched material formed on a substrate, and a mask formed on said hardly-etched film, said method comprising the steps of:

etching said layer of hardly-etched material using said mask;

washing out an etching product in the middle of the etching; and

again etching said layer of hardly-etched material using said mask.

14. A semiconductor device fabricated by the method of manufacturing a semiconductor device according to claim 13, comprising:

a substrate; and

at least one layer of hardly-etched material formed on said substrate, said layer of hardly-etched material having a side wall, the taper angle of which changes in the middle of said side wall.

15. A semiconductor device fabricated by the method of manufacturing a semiconductor device according to claim 13, comprising:

a substrate; and

at least two layers of hardly-etched material formed on said substrate, wherein one of said at least two layers of hardly-etched material is formed with a side wall having a taper angle different from a taper

angle of a side wall of the other layer of hardly-etched material.

16. An etching method for attaching a reaction product on a wall of an etching apparatus, comprising the step of:

continuously attaching said reaction product to the wall of said etching apparatus until at least one wafer has been processed, such that an etched material formed on a substrate has a side wall angled substantially at 90 degrees with respect to the surface of said substrate.

17. An etching method according to claim 16, further comprising the step of:

periodically removing said reaction product attached on the wall of said etching apparatus.

18. An etching method according to claim 16, further comprising the step of:

etching the etched material using a mask having a side wall angled at less than 90 degrees with respect to the surface of said substrate.

19. A method of etching a material under processing using a semiconductor device fabricating apparatus comprising a wafer carrier, a plurality of processing chambers and a plurality of post-processing chambers connected to said wafer carrier, a plurality of lock chambers, and an atmosphere carrier located adjacent to said lock chambers, wherein said atmosphere carrier can be connected to said plurality of lock

chambers, and a wafer cassette adjacent to said atmosphere carrier, said method comprising the steps of:

etching the material under processing in one of said plurality of processing chambers;

post-processing the material under processing in one of said plurality of post-processing chambers;

etching the material in one of said plurality of processing chambers; and

post-processing the material under processing in one of said plurality of post-processing chambers.

20. A method of etching a material under processing using a semiconductor device fabricating apparatus comprising a wafer carrier, a plurality of processing chambers connected to said wafer carrier, a plurality of lock chambers, and an atmosphere carrier located adjacent to said lock chambers, wherein said atmosphere carrier can be connected to said plurality of lock chambers, a post-processing chamber adjacent to said atmosphere carrier, and a wafer cassette adjacent to said atmosphere carrier, said method comprising the steps of:

etching the material under processing in one of said plurality of processing chambers;

post-processing the material under processing in said post-processing chamber;

etching the material in one of said plurality of processing chambers; and

post-processing the material under processing in said post-processing chamber.

21. A plasma-based method of etching a film formed of any of Pt, Ru, Ir, PZT, SBT, Co, Mn and Fe on a substrate, using said mask and a hard mask formed on said film, said method comprising the step of:

etching said film using said hard mask, said hard mask having a side wall angled at less than 80 degrees with respect to a surface of said substrate.